Summary of "Antibiotic Utilization in Seniors Prior to Hospitalization for Community-acquired Pneumonia Decreases Subsequent Hospital Mortality"

By T.J. Marrie, K.C. Carrière, Y. Jin, and D. Johnson

Purpose

Most cases of community-acquired pneumonia are both treatable and curable with appropriate antibiotics. Appropriate antibiotics alter mortality in hospitalized community-acquired pneumonia. However, antibiotic therapy guidelines for community-acquired pneumonia are variably followed. Considerable variation exists in outpatient antibiotic prescribing practice for community-acquired pneumonia perhaps, in part, because better outcomes from prescribing appropriate antibiotics have not been shown. This study analyzed the association of the prescription of outpatient antibiotics upon the subsequent hospital mortality for community-acquired pneumonia.

Approach

In this study, Alberta Health and Wellness administrative data from April 1, 1994 to March 31, 1999 was used from Alberta to profile the spectrum of antibiotics prescribed for seniors in the fourteen days prior to a subsequent hospitalization for community-acquired pneumonia.

Key findings

The following are the key findings of this study:

- Records for 21,191 seniors hospitalized for community-acquired pneumonia were analyzed during the study period.
- In about forty-three percent of hospitalizations (n = 9,034), a physician was consulted prior to the subsequent pneumonia hospital admission.
- Antibiotics were dispensed to thirty-one percent of those with a prior physician visit and in about seventy-seven percent of those prescribed an antibiotic, the antibiotic choice would have been appropriate for the treatment of ambulatory community-acquired pneumonia.
- The chances of dying were significantly lower in those with prior physician visits and with an antibiotic prescription.
- Three specific outpatient prescriptions (clindamycin, clarithromycin, and erythromycin) were effective in reducing subsequent in-hospital mortality compared to the outpatient prescription of other antibiotics. Prescription of clindamycin, clarithromycin, and erythromycin resulted in an about a 1.2 percent absolute and 17 percent relative mortality reduction.

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Conclusions

Ambulatory patients who were treated by a physician or were treated by a physician and received any antibiotic in the two weeks prior to hospitalization for community-acquired pneumonia had a decreased chance of dying during the subsequent hospitalization. Outpatient treatment with clarithromycin, erythromycin or clindamycin in the two weeks prior to a hospitalization for community-acquired pneumonia was associated with a lower in-hospital mortality when compared to those receiving other antibiotics for treating community-acquired pneumonia.

This study provides indirect evidence that when antibiotics are chosen for community-acquired pneumonia, this outpatient antibiotic choice may be associated with better outcomes if a subsequent hospitalization ensues. If true, the premise that antibiotic choices for community-acquired pneumonia should adhere to recommended guidelines are legitimized. This study does not allow speculation about the appropriate indications of prescribing or not prescribing an antibiotic for ambulatory outpatients with pneumonia.

The antibiotics prescribed in this retrospective study are dated and have changed locally with the popularization of newer choices. This study cannot make specific recommendations with respect to the current "antibiotic of choice" for ambulatory treatment of community-acquired pneumonia.

For more information

Copies of the report are available from the

Alberta Centre for Health Services Utilization Research

- by contacting David Johnson by e-mail at cujecjohnson@shaw.ca
- at http://www.health.gov.ab.ca/system/key/Research/achsur_reports.html

Alberta Centre for Health Services Utilization Research

The Alberta Centre for Health Services Utilization Research is a joint initiative between the University of Alberta and the University of Calgary, funded by Alberta Health and Wellness. The Centre conducts studies of how health services are used and delivered to inform health policy development and management of health services delivery.

Release date

August, 2003

ANTIBIOTIC UTILIZATION IN SENIORS PRIOR TO HOSPITALIZATION FOR COMMUNITY-ACQUIRED PNEUMONIA DECREASES SUBSEQUENT HOSPITAL MORTALITY

READER SURVEY

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Edmonton, AB T5J 2N3
Fax: (780) 422-2880

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2. In terms of length, was the report:

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1. Did the technical report contain the information that you needed?

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   a) All ☐
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      i. Exec summary ☐
      ii. Introduction ☐
      iii. Purpose ☐
      iv. Methods ☐
      v. Findings ☐
      vi. Discussion ☐
      vii. Recommendations ☐

5. Was report timely?

   Yes ☐ No ☐

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3. The findings were presented clearly.

   Yes ☐ No ☐

4. The tables and figures helped me to understand the findings.

   Yes ☐ No ☐

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Antibiotic Utilization in Seniors Prior to Hospitalization for Community-Acquired Pneumonia Decreases Subsequent Hospital Mortality

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Alberta Centre for Health Services Utilization Research

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SUMMARY

We analyzed the association of mortality and prescription of antibiotics prior to hospitalization for community-acquired pneumonia. We used administrative data for seniors (age sixty-five years and over) for Alberta, Canada from April 1, 1994 to March 31, 1999. We analysed 21,191 seniors hospitalized for community-acquired pneumonia during the study period. In about forty-three percent of hospitalizations (n = 9,034), a physician was consulted prior to the subsequent pneumonia hospital admission. The diagnoses made during the ambulatory physician visits were pneumonia (six percent), all other respiratory diseases (fifteen percent), and other diagnosis (seventy-nine percent). Antibiotics were dispensed to thirty-one percent of those with a prior physician visit and in about seventy-seven percent of those prescribed an antibiotic, the antibiotic choice would have been appropriate for the treatment of ambulatory community-acquired pneumonia. The odds for mortality were significantly decreased in those with prior physician visits (odds ratio = 0.87, $p < 0.01$) and with an antibiotic prescription (odds ratio = 0.66, $p < 0.0001$). In this study, we found clindamyacin, Clarithromycin, and erythromycin outpatient prescriptions to be highly effective in reducing subsequent in-hospital mortality (odds ratio = 0.61; 95% CI 0.39, 0.96) compared to the outpatient prescription of other antibiotics.

We conclude that ambulatory patients who were treated by a physician or were treated by a physician and received any antibiotic in the two weeks prior to hospitalization for community-acquired pneumonia had a decreased mortality risk during the subsequent hospitalization. Outpatient treatment with Clarithromycin, erythromycin or clindamycin in the two weeks prior to a hospitalization for community-acquired pneumonia was associated with a lower in-hospital mortality when compared to those receiving other antibiotics for treating community-acquired pneumonia.

INTRODUCTION

Community-acquired pneumonia is a common reason for hospital admission with an annual incidence of twelve per one thousand adults in which approximately fifteen percent of cases are admitted to hospital [1, 2]. Thirty-day mortality for those hospitalized is fifteen percent [3-6]. The high mortality for community-acquired pneumonia requiring hospitalization is likely related to its occurrence in those with serious chronic diseases and the elderly [7]. Most cases of community-acquired pneumonia are both treatable and curable with appropriate antibiotics. Appropriate antibiotics alter mortality in hospitalized community-acquired pneumonia [11]. However, empiric antibiotic therapy guidelines for community-acquired pneumonia are variably followed [8]. Considerable variation exists in outpatient antibiotic prescribing practice for community-acquired pneumonia [10] perhaps, in part, because better outcomes from prescribing appropriate antibiotics have not been well documented.

In this study, we used administrative data from April 1, 1994 to March 31, 1999 in one Canadian province to profile the spectrum of antibiotics prescribed for seniors in the fourteen days prior to a subsequent hospitalization for community-acquired pneumonia. We analyzed the association of the prescription of outpatient antibiotics upon the subsequent hospital course (length of hospital stay and mortality) for community-acquired pneumonia.

METHODS

Defining Pneumonia and Data Extraction:

Four administrative health service databases were used and the analysis was done within the protected environment of Alberta Health and Wellness, which is governed by provincial legislative guidelines on the confidentiality of health information. These data capture nearly the entire population and included a unique anonymous personal identifier allowing linkage between databases. The databases were:

1. Canadian Institute for Health Information's Inpatient Discharge Abstract Database for the province of Alberta for 1994/1995 to 1998/1999,
2. Alberta Physician Claims Assessment System Database for 1994/1995 to 1999/2000,
3. Alberta Health Insurance Plan Registry File for 1994 to 2000, and
4. Alberta Blue Cross Drug Insurance plan for fiscal years 1994/1995 to 1999/2000.

Inclusion Criteria:

Community-acquired pneumonia was defined as the most responsible diagnosis or any of the other fifteen diagnosis codes defined to be Type 1 (the diagnosis existed prior to admission) with the 15th International Classification of Disease, Ninth Revision, Clinical Modification with ICD-9-CM values of 480.x to 487.x (pneumonia) excluding 484.x (pneumonia of infectious diseases classified elsewhere) [12, 13] found in the hospital abstracts.

Exclusion Criteria:

1. Not an Alberta resident or not treated in an Alberta acute care facility,
2. Adjacent diagnosis related group (ADRG) defining hospitalization for a surgical procedure,
3. Any previous hospitalization within ten days of incident pneumonia case
4. Age less than or equal to sixty-five years who are not eligible for the subsidized drug insurance plan,
5. Transfers from continuing care facility (nursing home, long term care, seniors lodge, or other continuing care institutions) because of the possibility that the prescription was provided within the facility, and
6. Aspiration pneumonia (ICD-9-CM 507.x) because of the low frequency of antibiotic prescriptions prior to hospitalization.

Seniors registered with the Alberta Health Care Insurance received prescriptions subsidized by Alberta Blue Cross. Anonymous patient identifiers were merged with the prescription database identifying each unique drug identification number. Appropriate empiric antibiotic prescription in the fourteen days prior to hospital admission was derived using consensus criteria [14]. Minimal appropriate antibiotic dosage was derived from the Canadian Compendium of Pharmaceuticals [15].

Physician visits for community-acquired pneumonia were extracted from the Alberta Physician Claims Assessment System Database. Physician visits were defined as consultation claims (coded as CPX 03.x[15]) for any diagnosis between two to fourteen days prior to admission date. The most responsible diagnosis was classified as community-acquired pneumonia (as defined above), any other respiratory diagnosis (ICD-9-CM 460 to 519.9, excluding pneumonia), or any other diagnosis. All physician characteristics were extracted from hospital discharge abstracts.

Patient Factors:

Demographic Factors Were:

1. Age (66 to 74, 75 to 84, or 85 or more years (age at the fiscal year-end is used)),
2. Sex,
3. Metropolitan or non-metropolitan region of residence,
4. Metropolitan or non-metropolitan region of service, and
5. Physician visit in the two to fourteen days prior to hospitalization.

Pneumonia Types Were:

1. Viral and influenza (ICD-9-CM 480.x, 487.x),
2. Mycoplasma (ICD-9-CM 483.0),
3. Pneumococcal pneumonia (ICD-9-CM 481.x),
4. Other bacterial (ICD-9-CM 482.x, excluding 482.9, 483.x, excluding 483.0), and
5. Unspecified source (ICD-9-CM 482.9, 485.x, 486.x).

Severity of Illness was Defined as any one or More of:

1. Special / intensive care unit admission (as defined by each hospital),
2. Diagnosis code of respiratory failure or arrest (ICD-9-CM 518.81, 799.1),
3. Diagnosis code of hypotension or shock (ICD-9-CM 458.xx, 785.5x),
4. Procedure code for mechanical ventilation greater than ninety-six hours (ICD-9-CM 96.72).

Comorbidity was calculated as Charlson's comorbidity index using established definitions [17, 18] and aggregated as none, one, two, or more than two.

Hospital Volume:

Defining Hospital Type by Patient Volume:

At the time of this study, all hospitals in Alberta are administered by an autonomous regional board in each of the seventeen health regions. Nearly all three million residents of Alberta are enrolled in the public health care insurance plan and reside in one of the seventeen health regions. Hospitals admitting patients with community-acquired pneumonia were categorized into five groups on the basis of the average number of hospital discharges per year over the five-year study period, geographic location, and medical school proximity:

Rural

- Less than fifty cases per year comprising seventy-seven hospitals;
- Fifty to 108 cases per year comprising twenty-seven hospitals;

The rural hospital cut-off values for pneumonia cases of 50 and 108 represented the 50^{th} and 75^{th} percentiles of the volume of pneumonia cases in all Alberta patients.

Regional

- Five hospitals located in one of the five non-metropolitan regional health care cities ranging from 67 to 251 cases per year and one high volume rural hospital accounting for 221 cases per year;

Metropolitan

- Seven hospitals located in the metropolitan health regions of Calgary and Capital hospitals ranging from 92 to 813 cases per year;
- Two hospitals located adjacent to medical schools with one hospital in each of two metropolitan centres ranging from 493 and 610 cases per year.

Outcomes:

Length of Stay

Length of stay was calculated as days between discharge and admission date. Alternate (not acute care) levels of care days were subtracted from the length of stay. Transfers were attributed to the index admission and cumulative hospital length of stay calculated for an episode of pneumonia.

In-Hospital Mortality

Mortality was flagged in each hospital discharge abstract.

STATISTICS

Logistic regression was used to test the association between mortality and length of stay greater than the median to obtain adjusted rates in the following sequence:

1. Whether or not a physician visit prior to hospitalization occurred,
2. Whether or not any antibiotic was prescribed within the two weeks before hospitalization for community-acquired pneumonia,
3. If an antibiotic was prescribed, whether or not an appropriate antibiotic for community-acquired pneumonia was prescribed within the two weeks before hospitalization for community-acquired pneumonia, and
4. If an appropriate antibiotic was prescribed, whether or not the appropriate antibiotic was a macrolide or clindamycin.

Covariates were year of hospitalization, age (66 to 74, 75 to 84, over 85), sex, metropolitan / non-metropolitan residence region, metropolitan / non-metropolitan service region, hospital type, special / intensive care unit admission, diagnosis code of respiratory failure / arrest, diagnosis code of hypotension / shock, procedure code for ventilation greater than ninety-six hours, and number of comorbid diagnosis (0, 1, 2, > 2). The unit of analysis was hospital discharge with some patients being hospitalized on multiple occasions per year. In analogous studies, we attempted to adjust for correlations in hospital discharges within the same subject, but it did not result in substantial difference from those under the assumption of zero correlation. Therefore, we opted to report results of a simpler approach based on multiple logistic models [19-21]. Data was analyzed using the program SAS 8 [SAS Institute Inc. Cary, NC 2000] and significance was defined as $p < 0.05$.

RESULTS

Table 1 lists the antibiotics prescribed for Alberta seniors as outpatients within the two weeks prior to a subsequent hospitalization for community-acquired pneumonia in the time interval of April 1, 1994 to March 31,1999. These antibiotics were classified as appropriate or not appropriate for the treatment of ambulatory community-acquired pneumonia and a minimal daily dose calculated (Table 2). Clarithromycin was the most frequent prescription (about twenty percent). About seventy-eight percent of the outpatient antibiotic prescriptions would have been deemed appropriate for the treatment of community-acquired pneumonia using our study algorithm. If more than one antibiotic was prescribed, only one choice was required to be appropriate. Antibiotic dosing was considered adequate in over ninety percent of appropriate antibiotic choices. Inappropriate prescriptions were more expensive with seniors paying nearly twice the out-of-pocket expense (dispensing fee).

Hospitalization of 21,191 seniors occurred during the study period (Table 3). The etiology of most cases of pneumonia (about seventy-six percent) was not specified in the hospital abstract. In about forty-three percent of hospitalizations (n = 9,034) for community-acquired pneumonia, a physician was consulted prior to hospital admission. Antibiotic prescriptions were dispensed to 2,825 of these seniors (about thirty-one percent of those with a prior physician visit). Physician consultations prior to hospitalization for community-acquired pneumonia were for the diagnosis of pneumonia (six percent), all respiratory diseases (fifteen percent), and other diagnosis (seventy-nine percent).

As shown in Table 4, the study cohort had a mean age of seventy-eight years; almost half were female, and more were likely to live and be treated in a non-metropolitan region (i.e. neither Calgary nor Edmonton). Demographics and comorbidity were comparable in the pair wise comparisons of prior physician visit (contrast to no visit), any antibiotic (contrast to no antibiotic), and appropriate antibiotic (contrast to inappropriate antibiotic). In-hospital severity of illness tended to be greater in the pair wise comparisons for those without a prior physician visit (contrast to with a prior visit), for those not prescribed an antibiotic (contrast to any antibiotic prescribed), and those prescribed an inappropriate antibiotic (contrast to appropriate antibiotic prescribed).

Both the length of stay and mortality tended to decline in those with prior physician visit, with any antibiotic prescription, and an appropriate antibiotic prescription (Table 5). The odds were significantly decreased for length of stay for those with an antibiotic prescription. The odds for in-hospital mortality were significantly decreased for those with prior physician visit, with any antibiotic prescription, and when the appropriate antibiotic chosen was a macrolide or clindamycin. In this study, we found clindamycin / erythromycin / Clarithromycin to be highly effective in reducing the in-hospital mortality (odds ratio = 0.61) with 95% CI of (0.39, 0.96). Prescription of a macrolide or clindamycin compared to the prescription of other appropriate antibiotics resulted in an about a 1.2 percent absolute and seventeen percent relative mortality reduction.

DISCUSSION

We believe that this is the first study to associate a specific outpatient antibiotic prescription prior to hospitalization for community-acquired pneumonia with subsequently decreased in-hospital mortality. The absolute risk reduction comparing macrolides or clindamycin antibiotics compared to other antibiotics appropriate for the ambulatory treatment of community-acquired pneumonia was 1.2 percent (relative risk reduction of seventeen percent). As well, patients who had an ambulatory physician visit prior to hospitalization were also at decreased risk of in-hospital mortality. Patients with both an ambulatory physician visit prior to hospitalization for community-acquired pneumonia and any antibiotic prescription (seventy-eight percent of antibiotics deemed appropriate for community-acquired pneumonia) were associated with a decreased length of hospital stay and in-hospital mortality. These results underscore the importance of ambulatory care in those patients subsequently hospitalized for community-acquired pneumonia.

This study provides indirect evidence that when macrolide or clindamycin antibiotics are chosen for ambulatory community-acquired pneumonia, this antibiotic choice may be associated with better outcomes if a subsequent hospitalization ensues. If true, the premise that antibiotic choices for community-acquired pneumonia should adhere to recommended guidelines are legitimized [14, 22]. The literature suggests antibiotic choices for community-acquired pneumonia are often inappropriate [14, 23, 24]. In this study, seventy-seven percent of all antibiotic regimens prescribed would have been deemed appropriate for the treatment of community-acquired pneumonia. Our calculated appropriateness rate may have been lower in this study if more detailed clinical information had been available (i.e. past use of steroids) limiting the choices of appropriate antibiotics. A poorer outcome due to the absence of appropriate ambulatory antibiotic therapy has also been shown in other types of infectious diseases [25]. This study does not allow us to speculate about the appropriate indications of prescribing or not prescribing an antibiotic for ambulatory outpatients with pneumonia. Rather we simply associate the use of antibiotics and hospital outcomes for some patients in the two weeks prior to a subsequent hospital admission for community-acquired pneumonia.

Only about forty percent of seniors living at home accessed a physician in the two weeks prior to hospitalization for community-acquired pneumonia. Those who saw physicians had similar comorbidity to those who did not, however in-hospital severity of illness and mortality were greater in those persons who did not see a physician. We would have anticipated that sicker ambulatory patients would have had a greater tendency to visit a physician prior to hospitalization. Thus any remaining confounding due to patient selection bias towards greater severe illness / comorbidity should have tended to increase mortality in those patients that saw a physician or received an

antibiotic prior to hospitalization. The diagnosis of community-acquired pneumonia or other respiratory illness was made in twenty-one percent of patients' pre-hospitalization visits yet about thirty-one percent of patients with a pre-hospitalization visit were prescribed an antibiotic. This study does not address issues concerning the choice to prescribe or withhold antibiotics during an ambulatory outpatient visit in which the diagnosis of pneumonia is considered. Rather, this study simply investigates the period just prior to a pneumonia hospitalization and compares the subsequent hospital course of those patients who did or did not receive an antibiotic (without focusing upon the actual diagnosis for which the antibiotic prescription was made).

Fantin [9] prospectively studied one hundred and seventeen outpatients with community-acquired pneumonia and found that severity of illness rather than antibiotic choice was related to the twenty-one hospitalizations and five hospital deaths [9]. Our retrospective study included over 20,000 hospitalizations for pneumonia and over 2,000 deaths occurred. Our larger cohort may have been better able to detect the effect of outpatient antibiotics in seniors who were subsequently hospitalized. Our study cohort included only those patients subsequently hospitalized, so we can make no inferences about the ambulatory treatment for non-hospitalized community-acquired pneumonia. Although over-prescription of antibiotics without appropriate reason has detrimental effects such as multiple antibiotic resistance [28], so too, may the incorrect selection of antibiotics when appropriate indications exist [30].

The antibiotics prescribed in this retrospective study are dated and have changed locally with the popularization of newer choices [2]. A prospective observational trial in metropolitan Edmonton and surrounding area showed that macrolide monotherapy (azithromycin, Clarithromycin, and erythromycin) comprised fifty-five percent of all prescriptions [31]. The decreased mortality associated with the clindamycin, Clarithromycin, and erythromycin in this study supports the current local choices of azithromycin, Clarithromycin, and erythromycin made for the treatment of ambulatory community-acquired pneumonia. In our study, categorizing an antibiotic such as sulfamethoxazole / trimethoprim as appropriate, may now be considered questionable, because of the emergence of resistant pneumococcal strains [28]. However in our study, categorizing sulfamethoxazole / trimethoprim as appropriate or inappropriate did affect the overall study conclusions (data not shown). As bacterial sensitivity to antibiotics change over time [10, 26] and physician prescription choices also vary geographically [14, 27], retrospective observational studies cannot make specific recommendations with respect to the current "drug of choice".

Our study has several limitations. Population-based administrative database research is highly generalizable although limited in clinical details. We attempted to adjust for case severity (special care unit admission, hypotension / shock, respiratory arrest / failure, and mechanical ventilation) and case mix (comorbidity, age, sex, and residence) but may not have captured all variation [32]. These variables are likely less reliable than a clinically derived severity of pneumonia index [2]. We have records of only

formulary antibiotics prescribed. We have no information upon the actual use of the prescribed antibiotic or the use of non-formulary antibiotics not covered by the drug insurance plan. All of these factors would tend to diminish the observed effect of antibiotics that we were able to track. We excluded those seniors receiving continuing care services as antibiotics may have been dispensed by a health care facility and not provided by the drug insurance plan. Our results may not be generalizable to those residing in continuing care facilities that are at an overall increased risk of poorer outcomes [33]. The high percentage of cases of pneumonia of unknown etiology was similar to other administrative data studies [29], reinforcing the relevance of guidelines for empiric antibiotic therapy.

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Table 1 – Appropriate (as Defined by Consensus of Expert Opinion Guidelines) and Inappropriate Antibiotics Prescribed in Alberta for Patients Subsequently Hospitalized for Community-Acquired Pneumonia

Appropriate Single Agent Prescription	Antibiotic (Daily Minimal Dose)
	Macrolide / Lincosamide Clindamycin (900 mg) Erythromycin (1 gm) Clarithromycin (500 mg)
	Respiratory fluoroquinolone Levofloxacin (500 mg)
	Penicillin (group 1) Amoxicillin-clavulanate, Amoxicillin, Ampicillin, Pivampicillin (1 gm) Penicillin V (1.2 gm)
	Tetracycline (group 1) Doxycycline (200 mg)
	Betalactam (group 1) Cefadroxil (1 gm) Cefazolin (1 gm) Cefixime (400 mg) Cefuroxime (2.25 gm) Cephalexin (1 gm)
	Other Sulfamethoxazole/trimethoprim (1600 / 320)
Inappropriate single agent or absence of appropriate agent in combination with one of these agents	Ceflacor, Ceftriaxone, Cloxacillin, Minocycline, Tetracycline, Vancomycin, Sulfamethoxazole, Sulfasalazine, Trimethoprim, Nitrofurantoin, Ciprofloxacin, Norfloxacin, Ofloxacin, Metronidazole, Gentamycin, and Tobramycin.

Note: antibiotic dose in parenthesis is minimal daily dose for a duration of ten days.

Table 2 – Antibiotics Utilization Profile as Outpatient in Seniors Prior to Hospitalization for Community-Acquired Pneumonia From April 1, 1994 to March 31, 1999

Recommended Antibiotic	All Prescriptions n = 3,111
Appropriate antibiotic; n (%)	2,329 (74.86%)
Clindamycin	22 (0.71%)
Erythromycin	206 (6.62%)
Clarithromycin	655 (21.05%)
Levofloxacin	21 (0.68%)
Ampicillin / Amoxicillin group	530 (17.04%)
Penicillin	39 (1.25%)
Doxycycline	141 (4.53%)
Cefadroxil	23 (0.74%)
Cefazolin	1 (0.03%)
Cefixime	9 (0.29%)
Cefuroxime	20 (0.64%)
Cephalexin	352 (11.31%)
Sulfamethoxazole / Trimethoprim	332 (10.67%)
Inappropriate antibiotic; n (%)	760 (24.43%)
Number of antibiotic per prescription	1.1

Table 3 – Etiology and Treatment (Number and Percent) of Hospitalizations for Community-Acquired Pneumonia in Alberta During April 1, 1994 to March 31, 1999

	All Hospital Discharges For Community-Acquired Pneumonia n = 21,191
Etiology	
Viral and influenza pneumonia	2,128 (10.0%)
Mycoplasma pneumonia	70 (0.3%)
Pneumococcal pneumonia	1,616 (7.6%)
Other bacterial	1,258 (5.9%)
Unspecified pneumonia	16,119 (76.1%)
Treatment	
Physician visit prior to hospitalization	9,089 (42.9%)
Any prior antibiotic prescription with a physician visit	2,825 (31.1%)
Any prior appropriate antibiotic prescription	2,196 (77.7%)
Appropriate antibiotic dosing of any appropriate antibiotic prescription	1,990 (90.6%)
Antibiotic costs ($)	
Per patient hospitalization cost of appropriate antibiotic prescription ($)	$21.29
Per patient hospitalization cost of inappropriate antibiotic prescription ($)	$38.04

Table 4 – Demographics, Comorbidity, and Severity of Illness (Number and Percent) for Hospitalized Community-Acquired Pneumonia in Alberta During April 1, 1994 to March 31, 1999

	All n = 21,191	Prior Visit to a Physician n = 9,089	No Prior Visit to a Physician n = 12,102	Any Antibiotic n = 2,825	No Antibiotic n = 18,366	Appropriate Antibiotic n = 2,196	Inappropriate Antibiotic n = 629
Age (Mean, SD)	78.4 (7.5)	77.8 (7.1)	78.9 (7.7)	78.0 (7.5)	78.5 (7.4)	78.0 (7.5)	77.8 (7.6)
Female	9,804 (46.3%)	4,164 (45.8%)	5,640 (46.6%)	1,462 (51.8%)	8,342 (45.4%)	1,139 (51.9%)	323 (51.4%)
Metropolitan Service Hospital	9,196 (43.4%)	4,092 (45.0%)	5,104 (42.2%)	1,193 (42.2%)	8,003 (43.6%)	931 (42.4%)	262 (41.7 %)
Metropolitan Residence	8,889 (41.9%)	3,972 (43.7%)	4,917 (40.6%)	1,192 (42.2%)	7,697 (41.9%)	930 (42.3%)	262 (41.7%)
Comorbidity (Mean, SD)	1.3 (1.1)	1.4 (1.1)	1.3 (1.1)	1.2 (1.1)	1.3 (1.1)	1.2 (1.1)	1.3 (1.0)
Special / Intensive Care Unit Admission	1,611 (7.6%)	678 (7.5%)	933 (7.7%)	167 (5.9%)	1,444 (7.9%)	128 (5.8%)	39 (6.2%)
Respiratory Failure or Arrest	965 (4.6%)	384 (4.2%)	581 (4.8%)	128 (4.5%)	837 (4.6%)	98 (4.5%)	30 (4.8%)
Hypotension or Shock; n (%)	510 (2.4%)	215 (2.4%)	295 (2.4%)	50 (1.8%)	460 (2.5%)	36 (1.6%)	14 (2.2%)
Ventilation Greater Than Ninety-Six Hours	225 (1.1%)	84 (0.9%)	141 (1.2%)	24 (0.8%)	201 (1.1%)	19 (0.9%)	5 (0.8%)

Table 5 – Length of Stay and Mortality of Hospitalizations for Community-Acquired Pneumonia in Alberta During April 1, 1994 to March 31, 1999

	Length of Stay in Days (Mean, 95% CI)	Odds Ratio (95% CI)	In-Hospital Mortality (%, 95% CI)	Odds Ratio (95% CI)
	Unadjusted		Unadjusted	
All	10.53 (10.26, 10.81)		11.48 (11.05, 11.91)	
Prior visit to a physician	10.10 (9.87, 10.33)	0.96 (0.91, 1.02)	10.79 (10.16, 11.43)	0.87 (0.79, 0.95)
No prior visit to a physician	10.85 (10.41, 11.30)		12.00 (11.42, 12.58)	
With prior visit				
Any antibiotic	9.22 (8.85, 9.59)	0.87 (0.79, 0.97)	7.65 (6.51, 8.79)	0.66 (0.55, 0.80)
No antibiotic	10.37 (10.10, 10.64)		11.75 (10.99, 12.51)	
With any antibiotic				
Appropriate antibiotic	9.13 (8.71, 9.55)	0.95 (0.76, 1.18)	7.41 (6.14, 8.68)	0.84 (0.56, 1.26)
Inappropriate antibiotic	9.49 (8.52, 10.46)		8.51 (5.98, 11.04)	
With any macrolide				
Macrolide antibiotic	8.93 (8.27, 9.59)	0.88 (0.71, 1.09)	6.21 (6.19, 6.23)	0.61 (0.39, 0.96)
No macrolide antibiotic	9.22 (8.61, 9.83)		7.39 (7.37, 7.41)	

BIOGRAPHIES

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